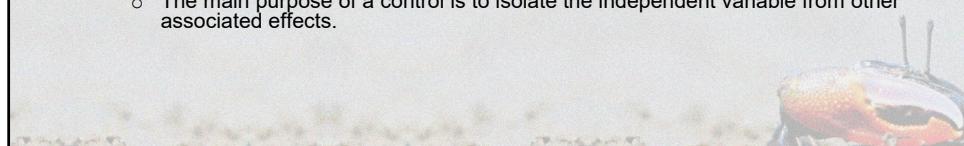




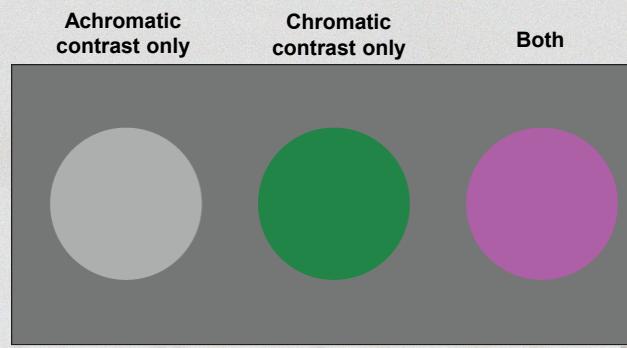
Key elements of a good experimental design

- **Replication:**
 - Estimation of errors
 - Increase in precision
 - Larger range of observations (i.e. larger sphere of inference)
- **Randomization:**
 - Assigning treatments to experimental units at random
 - Appropriate sampling of experimental data
 - Avoiding bias and other sources of variation that cannot be controlled
 - Basis for any valid statistical test
- **An adequate control:**
 - Placebo, sham injections, etc
 - The main purpose of a control is to isolate the independent variable from other associated effects.



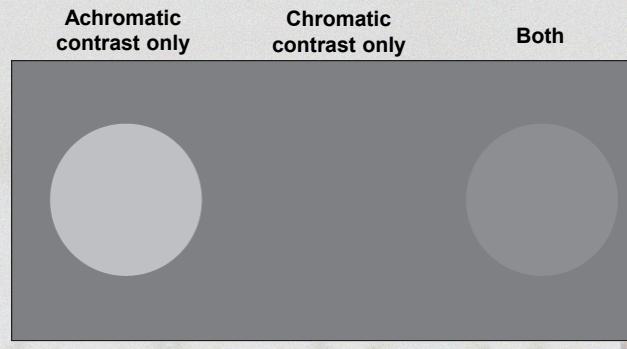
Testing for colour vision is all about controlling intensity!

Three objects on a grey background, all clearly visible:



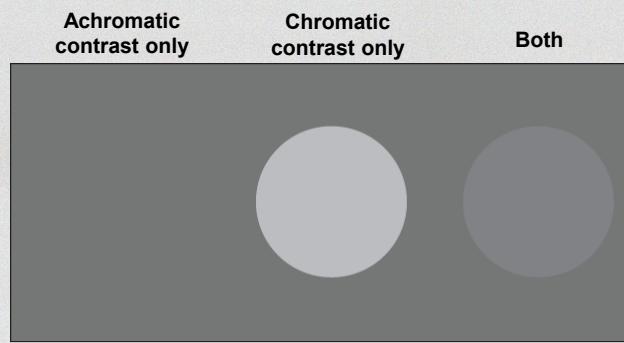
Achromatic and chromatic contrast

Viewed through brightness (luminance) channel only. In other words, viewed by a colour blind system



Achromatic and chromatic contrast

Viewed through spectral (colour) channel only



Testing for colour vision

The two most basic questions are:

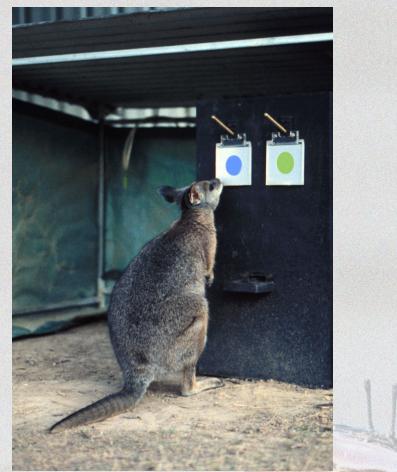
- Does an animal have colour vision?
- How many colour channels does the animal have? i.e. how many photoreceptor classes underlie the animal's colour vision?

Monochromacy? (colour blind)

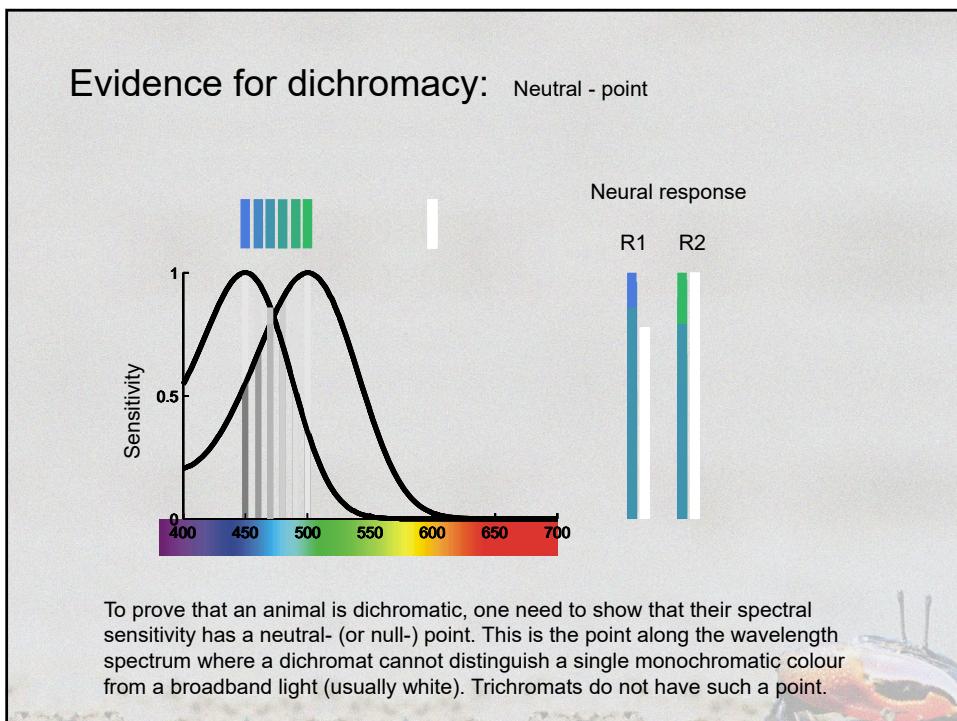
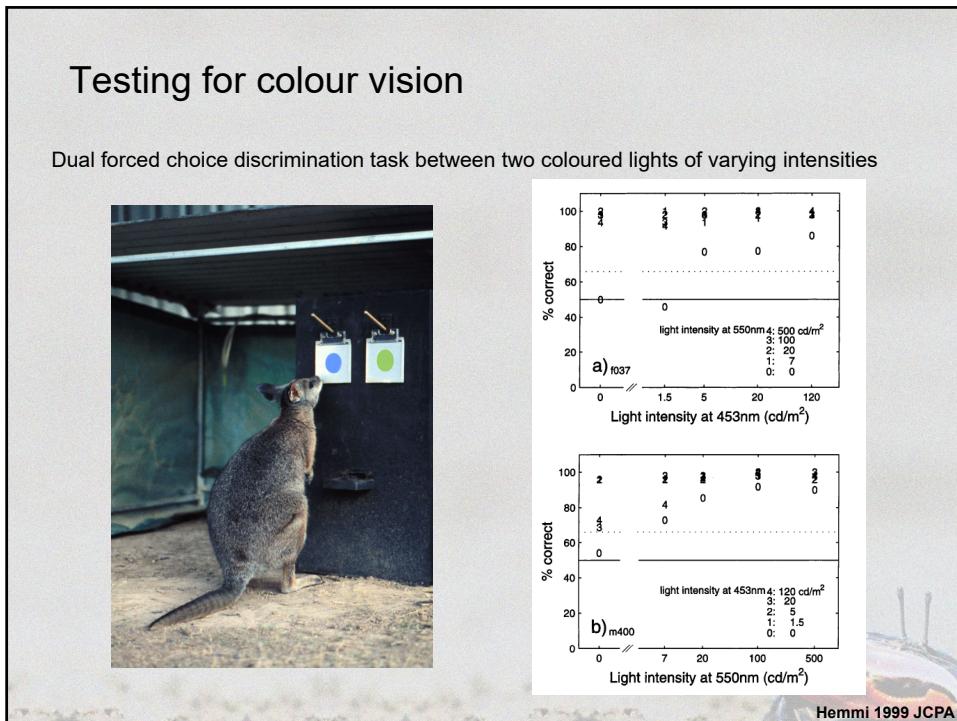
Dichromacy? (e.g. dogs/cats)

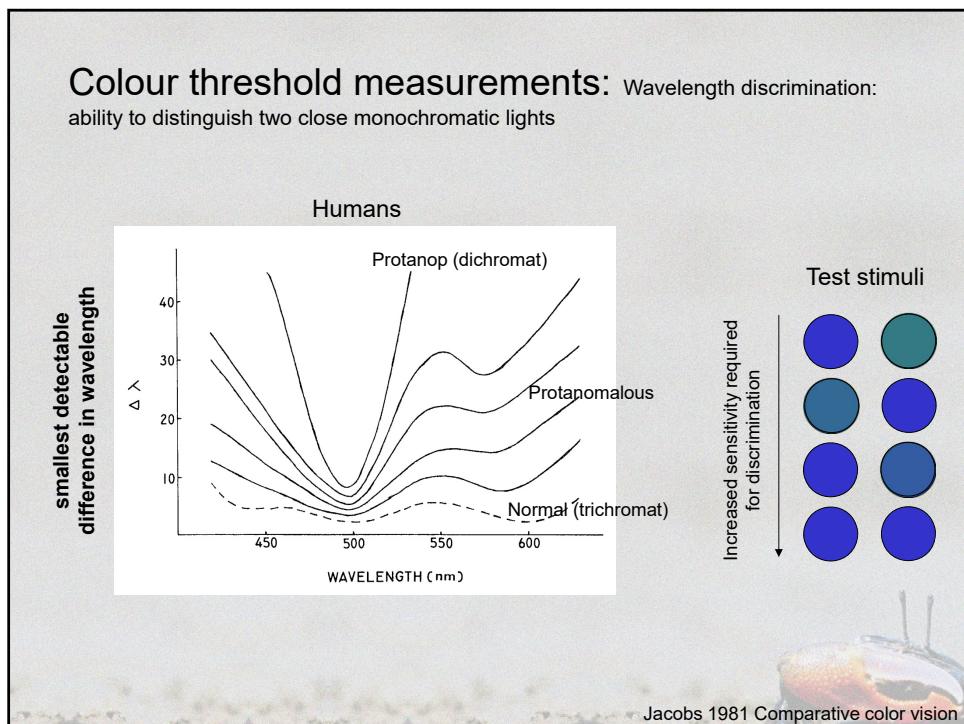
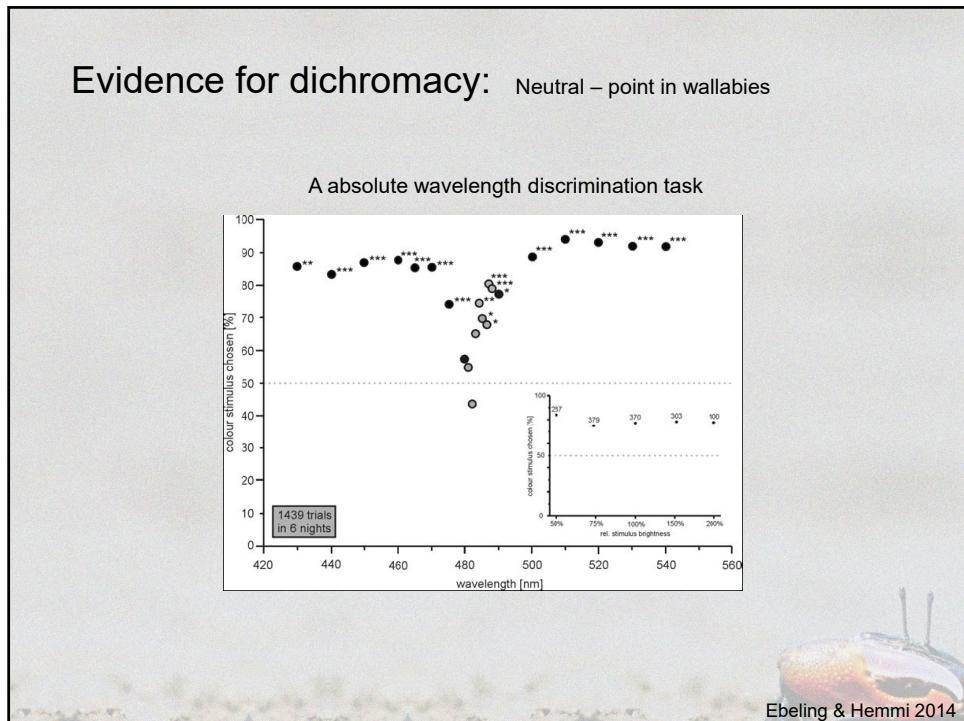
Trichromacy? (e.g. humans)

Tetrachromacy? (e.g. many birds and reptiles)



Hemmi 1999 JCPA





The main concepts

- Behavioural colour vision experiments are all about luminance! To show colour vision, one needs to eliminate brightness contrast.
- The null-point or neutral-point experiment is a conclusive way to show that an animal is a dichromat.
- Colour threshold experiments and colour mixing experiments (of which the null-point experiment is a special case), can be used to infer some of the underlying colour vision mechanisms e.g. the dimensionality of an animal's colour space.
- Don't forget the control!

